RECOMMENDATIONS FOR A STATE MANAGEMENT PLAN AT THE WAI'OPAE TIDE POOLS KAPOHO, HAWAII

Prepared by

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For

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EXECUTIVE SUMMARY

This recommended management plan is a companion document to a report provided to the Hawaii Department of Land and Natural Resources (DLNR) in May 2007: *Recommendations to improve the conservation of marine resources using the Wai'Opae Tide Pools Marine Life Conservation District rule and community-based "makai watch" marine conservation programs* (Flanders 2007a). The recommendations are based on all available scientific data collected at Wai'Opae and relevant information from other marine life conservation districts (MLCDs) in Hawaii.

The key recommendations made to DLNR to improve the conservation of marine resources at Wai'Opae are summarized below:

Rule Changes

Expansion of Boundaries:

- Extend the seaward boundary to the 100-fathom line so that boats can accurately locate it and the MLCD includes deeper habitats that large adults depend on for foraging, shelter, and spawning.
- Extend the northern boundary to Kapoho Point at the southern tip of Kapoho Bay so that shore-based fishers and boats can accurately locate the boundary, to expand the area of highly productive fish nursery pools that are protected, and to greatly increase the enforceability of rules due to the practical access constraints.

Additions to Prohibited Activities:

- Prohibit the possession of all forms of fishing gear within the MLCD so that illegal fishers cannot claim they are going to, or already did, fish outside of the MLCD.

DLNR Should Improve the Implementation of the MLCD Rule by June 2009:

- Determine human use thresholds (i.e., carrying capacity) to ensure the MLCD meets its purpose of protecting, conserving and improving the unique marine resources at Wai'Opae.
- Develop a site-specific Wai'Opae Management Plan that limits the number of visitors per day based on the human use thresholds, zones the shallow most fragile coral areas as off-limits to all public use, directs visitors to the least fragile areas, and identifies a long-term sustainable financing plan to fund a full-time on-site manager/ranger.

Management Plan

Management goals

- increased abundance and biomass of juvenile fish;
- increased abundance, biomass and average size of adult fish and invertebrate species targeted by fishers;

- relatively pristine coral reef with a low percentage of dead, broken or diseased coral;
- decreased cover of turf, coralline or macro algae due to increased abundance of herbivores and improved water quality;
- eradication of invasive species, especially red mangrove; and
- enhancement of adjacent fisheries (legal-sized catch per effort by gear type) in tide pools and nearshore marine waters adjacent to the MLCD.

Management Objectives

- Ensure sufficient on-site enforcement of the MLCD and statewide fishing regulations at Wai'Opae by DLNR to achieve the MLCD purposes and management goals.
- Establish a permit application process and issue appropriate permits for allowable educational purposes consistent with the purposes of the MLCD.
- Continue monitoring the effectiveness of the MLCD to scientifically determine if the rule, given the level of management and enforcement, is protecting, conserving and improving the marine resources within the MLCD. Report the monitoring results to the Board of Land and Natural Resources by June 16, 2008 regarding the effectiveness of the rule.
- Fund a DLNR biologist, biological technician, or ranger position to actively manage public use on site and educate visitors to increase compliance.
- Develop partnerships with non-governmental organizations and community groups that may help increase the cost-effectiveness of DLNR's management and enforcement activities at Wai'Opae tide pools. Help fund citizen's "makai watch" efforts that are deemed to be effective.

In summary, the chances of improving marine resources at Wai'Opae are far greater with both the recommended rule changes and the adoption and implementation of the recommended management plan. If the boundary of the MLCD is expanded, the management plan should apply to the entire area.

Purpose

The purpose of these recommendations is to independently evaluate and recommend to the DLNR a site-specific management plan that would increase on-site management and enforcement by the DLNR and result in more effective protection of the Wai'Opae Tide Pools Marine Life Conservation District (MLCD). The MLCD became law on June 16, 2003 with the purpose of "protecting, conserving, and improving the unique marine resources within its boundaries." The MLCD rule requires a review of the effectiveness of the MLCD after five years of being in effect. See figures 1, 2 and 3 for boundaries and aerial photographs of the MLCD.

These recommendations identify issues, threats, management objectives and activities that would help achieve the purposes of the MLCD. The recommendations identify opportunities for collaboration between DLNR and local communities and stakeholder groups (e.g., for reef watch activities) to cost-effectively manage the MLCD to achieve the intended purposes.

Description of Wai'Opae Tide Pools Resources

The geomorphology of the Wai'Opae tide pools is a barrier reef with a shallow reef flat and extensive intertidal zone generally protected from the pounding ocean surf by a seaward basalt ridge. The reef flat and outer tide pools have excellent water circulation. Some of the inner tide pools do not receive as much tidal flushing and are quite brackish (as low as 8 ppt). The reef flat contains many tide pools deep enough to support the growth of abundant and diverse coral. There are intricate lava crevices providing refuge for many species of fish and invertebrates.

Benthic habitat types were mapped in the field with the aid of very low-level aerial photographs. The types identified include the following (Flanders and San Filippo 2003):

- **Intertidal zone**: emergent vegetation (hau and/or mangrove), submerged vegetation (sea grass), reef rubble, encrusting coralline algae, uncolonized volcanic rock/boulder, and artificial dredge/fill;
- **Reef flat zone**: uncolonized volcanic rock/boulder, colonized volcanic rock/boulder, aggregated coral, aggregated patch reef, macroalgae, encrusting coralline algae, reef rubble, unconsolidated mud, and artificial dredge/fill; and
- **Reef crest zone**: uncolonized volcanic rock/boulder and colonized volcanic rock/boulder.

Lisa Wedding, a graduate student at the University of Hawaii at Manoa, developed a benthic habitat map for the Wai'Opae MLCD based on NOAA's benthic habitat classification system and extensive field surveys at Wai'Opae (L. Wedding, pers. comm. 2007). Her results are shown in figure 4.

Figure 1.

Waiopae Tidepools Marine Life Conservation District, Hawaii

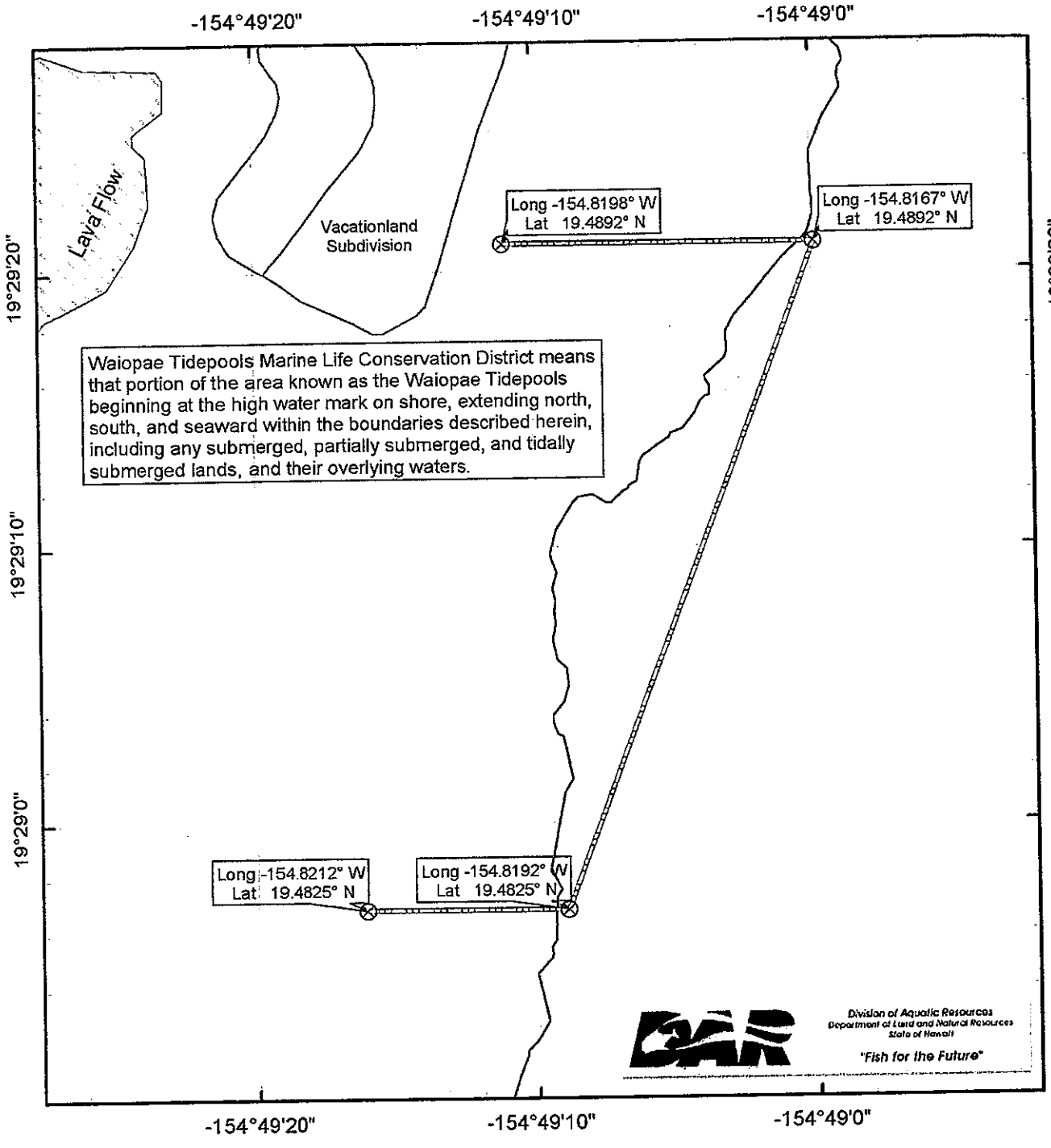
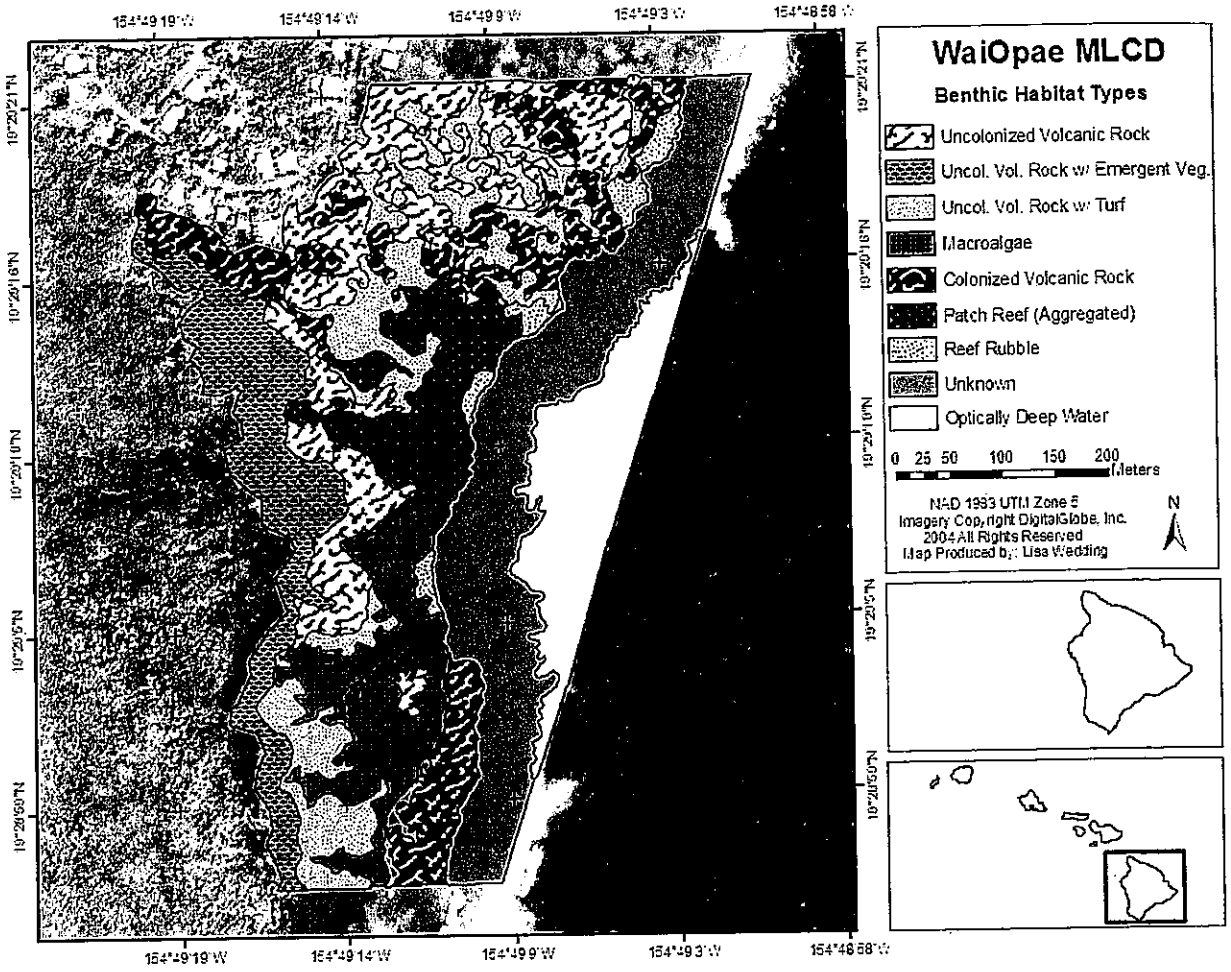


Figura 2.

Figure 5.

Figure 4



Habitat Type	Habitat Code	Acres	Perimeter Miles
Col. vol. rock w/ low density turf and coralline	CV	7.70	2.74
Patch reef with low density macroalgae and coralline	PR	5.17	1.20
Patchy macroalgae 10-50%	MA	5.71	1.45
Uncol. vol. rock w/ high density turf & low den. coralline	UVTU	8.18	3.53
Uncol. Vol. rock w/ low density turf & emergent veg.	UVEM	7.00	1.16
Uncolonized volcanic rock and boulder	UV	9.05	2.97
Reef rubble w/ medium density coralline & low den. turf	RR	1.20	0.52
Optically deep water	OP	6.27	0.86
Unknown	U	13.91	1.64

Leon Hallacher, a Professor in the Marine Sciences Department at the University of Hawaii Hilo, provided the following information (Hallacher 2007). An East Hawaii long-term monitoring program has four transects within each of three sites: Wai'Opae MLCD; Wai'Opae Open area with fishing; and Richardson's Ocean Center in Hilo that allows fishing. The number of survey days at each of the Wai'Opae sites ranged from 12 in 2000 to 2 in 2006, with a mean frequency of six surveys a year. When analyzing all of the 188 transect samples collected in East Hawaii between July 1999 and November 2006, the results show the following:

- the abundance of fishes at the Wai'Opae Open area is statistically higher than at Richardson's, and slightly higher than at the MLCD (mean of 122 vs. 109 individuals per 100 sq m);
- species diversity did not significantly differ between the three sites (ranged between 2.34 and 2.37);
- species richness was statistically higher at the MLCD than at Richardsons and slightly higher than at the Wai'Opae Open area (6.9 vs. 6.4 mean number of species per 100 sq m);
- fish abundance decreased at the MLCD during the first two years (2004 and 2005) after it was established, then showed a slight increase in 2006, but has not reached the abundance level of 2003. However, fish were more abundant in 2003 than in 1999-2002 and the levels recorded in 2004-2006 exceeded those recorded in 1999-2002; and
- fish abundance in the Wai'Opae Open area also decreased in the first two years after the MLCD was established in June 2003, but by 2006 greatly exceeded the levels recorded in 2003.

Alan Friedlander and Eric Brown (Friedlander et. al. 2006) surveyed 29 transects within Wai'Opae MLCD and 28 in the tide pools adjacent to the MLCD approximately one and a half years after the MLCD was law. Their transect surveys of substrate type indicated that the MLCD and adjacent tide pools open to fishing (Open area) are similar enough for a valid comparison of fish resources across the two types of fisheries management (closed to fishing vs. open to fishing). Some of their findings include:

- species richness and diversity were similar between the MLCD and Open area;
- biomass of all fishes combined was significantly higher in the MLCD;
- the ratio of fish biomass inside the MLCD and Open area was very low compared to other "no-take" MLCDs in Hawaii and only slightly higher than MLCDs with only partial fishing restrictions;
- fish trophic structure differed somewhat between areas open to fishing vs. those closed to fishing;
- herbivores represented 64% of the total fish biomass in the MLCD vs. 55% in the Open area. Secondary consumers were 34% of biomass in MLCD vs. 44% in Open area. Apex predators (primarily the introduced peacock grouper, roi) were 2% of biomass in the MLCD and 1% in the Open area;
- two important species targeted by fishers, the palenose parrotfish (*uhu*) and convict tang (*manini*), represented 35% of the total fish biomass in the MLCD versus 25% in the Open area;

- species richness, biomass, and diversity were low at Wai'Opae compared to other MLCDs in Hawaii, except Waikiki and Moku o Loe, because "the small size and shallow depth range of these protected areas limit their effectiveness for biodiversity conservation and fisheries replenishment." The Wai'Opae MLCD is 0.26 sq km and the third smallest of the 11 MLCDs in Hawaii.

The Cape Kumukahi Foundation conducted 42 surveys of fishes on each of 12 transects between May 2003 and July 2006 (Flanders 2007b). In summary, the data indicate that adults/subadults have declined over the past three years while juveniles/recruits have increased. Analyzing the data by MLCD vs. the area open to fishing (Open) indicates:

- within each of the three years of sampling, the MLCD had significantly greater numbers of species per transect line than the OPEN area;
- species richness decreased over the three years in both the MLCD and OPEN areas;
- within each of the three survey years, the MLCD had a higher average diversity of fishes than in the OPEN area;
- for all fishes combined and for all adult/subadult fishes combined, the average density and biomass significantly decreased from Year One to Year Three in both the MLCD and the Open area;
- the decline in biomass of all fishes combined and of adult/subadult fishes was greater in the Open area than in the MLCD;
- for juveniles/recruits, the average density and biomass were significantly greater in Year Two and Three than in Year One in both the MLCD and the Open area;
- the increase in density of juveniles/recruits from Year One to Year Three was greater in the MLCD than in the Open area;
- adult/subadult and juvenile/recruit parrotfishes (*Scaridae*), highly targeted for harvest, were more abundant in the MLCD than the Open area in all three years;
- the density of adult/subadult parrotfishes decreased over the three-year period in both the MLCD and the Open area, but there was a slight increase in Year Three in the MLCD compared to Year Two;
- the biomass of adult/subadult parrotfishes decreased in both the MLCD and Open area over the three-year period, but decreased far more in the Open area;
- the density of juvenile/recruit parrotfishes increased in the MLCD but decreased in the Open area over the three-year period;
- the density and biomass of adult/subadult surgeonfishes (*Acanthuridae*), highly targeted for harvest, decreased over the three-year period in both the MLCD and Open area and decreased more in the open area;
- the density of juvenile/recruit surgeonfishes increased over the three-year period in both the MLCD and Open area;
- both the adult/subadult and juvenile/recruit size classes of lavender tang (*Acanthurus nigrofuscus*), a commonly harvested species, were more abundant in the Open area than the MLCD in all three years but they decreased over the three-year period;
- Adult/subadult convict tang (*Acanthurus triostegus*), another commonly harvested species, decreased in both the MLCD and Open area over the three-year period

but became more abundant in the MLCD than in the Open area by the second and third year after the MLCD was designated;
- Juvenile/recruit convict tang were more abundant in the Open area than the MLCD and increased over the three-year period in both areas but increased far more in the Open area; and
- Adult/subadult bullethead parrotfish (*Chlorurus sordidus*), highly targeted for harvest, were more abundant in the MLCD than Open area but decreased over the three-year period.

Human Pressure at Wai'Opae Tide Pools

The Cape Kumukahi Foundation collected data on the patterns of human use at the Wai'Opae tide Pools since May 2003. The results from the first three years can be found in their third annual report (Flanders 2007b). The data from the fourth year is reported in Flanders 2007c.

An estimated 83,488 people used the Wai'Opae tide pools in Year Four (April 2006-March 2007). This is a slight decrease from the estimated 87,190 people in Year Three (April 2005 through March 2006), but substantially higher than the 57,463 people in Year Two and 46,000 in Year One. The slight decline is likely due to the adjacent community's increased efforts to educate and control the increasing number of visitors accessing the MLCD via private community roads. The community paid for increased signage to limit public parking spaces and a security guard that turns overflow cars away from the waterfront parking area when the 18 parking spaces are full. The vast majority of the visitors use a small portion of the 64-acre MLCD, so human impacts are highly concentrated. Human pressure on marine resources is also continuous throughout the year because the protected tide pools allow safe access nearly every day of the year.

Extensive surveys during Year Four documented the average number of visitors a day to the Wai'Opae tide pools was:
- 260 visitors on summer weekend and holiday days;
- 178 visitors on summer weekdays;
- from 189 to 296 visitors on fall/winter/spring weekend and holiday days depending on type of data used (counts of people vs. cars); and
- 208 visitors on fall/winter/spring weekdays.

In Year Four, 87% of visitors to the tide pools used the MLCD area, compared to 90% in Year Three, 86% in Year Two and 69% in Year One. In Year Four, 94% of visitors were doing non-consumptive activities, including snorkeling and relaxing on the shore, compared to 95% in Year Three, 94% in Year Two and 91% in Year One. This suggests that the MLCD designation is attracting more visitors to the area just as DLNR had expected would happen.

In Year Four, 180 people were counted fishing illegally within the MLCD during formal survey hours on 97 days, for an average of 1.9 illegal fishers per day during the day time. This is identical to the rate of illegal fishing documented in Year Three. Most of the

times when the Reef Stewards observed and recorded people fishing illegally, they also successfully convinced them to stop fishing in the MLCD and to obey the rules.

In Year Four, 49% of the cars appeared to be rental cars on weekdays, compared to 52% in Year Three. On weekends, 38% of visitor cars on weekends appeared to be rental cars in Year Four compared to 39% in Year Three.

Issues and Threats Related to DLNR Jurisdiction

Poaching

The rule specifies that no person shall take, injure, kill, possess, or remove any marine life within the MLCD. Poaching continues within the MLCD almost every day. Primary methods include gathering by hand, handnet, throw net, pole, and spear during the day. The use of stationary gill nets, both moemoe and pa'ipa'i style, used to be common but is now rarely observed in the MLCD area although it still occurs regularly in the tide pools open to fishing. Trolling from boats in the outer deeper waters of the MLCD is common. When sea conditions are very calm, spear fishing from dive boats in the outer portion of the MLCD just beyond the breakers occurs. Illegal fishing at night is common.

The first citation issued for illegal fishing within the MLCD was issued by DLNR on Sunday, September 16, 2007. Two men were laynetting in broad daylight with the community's security guard and Cape Kumukahi Foundation's reef steward on site and able to report the violation to DLNR. They harvested enough fish to fill a large backpack. During the first four and a quarter years of the MLCD, DLNR responded to illegal fishers with warnings.

Damage to Marine Life From Intensive Public Use of Shallow Coral Reef

The rule specifies that no person shall take, alter, deface, destroy, possess, or remove any sand, coral, rock, or other geological feature, or specimen. Damage to live coral and tube worms continues to occur due to trampling by people and dogs wading and standing in shallow water and entering and exiting the relatively deeper pools. Kayaking in the shallow tide pools is increasing and poses high risk of coral breakage. People are rarely observed intentionally breaking and taking live coral. Damage to coral has been documented at other locations in Hawaii from people swimming and snorkeling in water < 2 m deep (Holland and Meyer, 2003).

Unsustainable Fishing Pressure Within Interconnected Wai'Opae Tide Pools

Fish biomass inside the Wai'Opae MLCD was not much greater than in the tide pools open to fishing, very low compared to other "no-take" MLCDs in Hawaii, and barely higher than MLCDs allowing some types of fishing (Friedlander et al. 2006).

The intensive fishing pressure in the very small, interconnected Wai'Opae tide pool complex may be partially responsible. People using all types of fishing gear can park adjacent to the tide pools and easily harvest fish by walking across exposed tidal flats and wading through shallow tide pools (trampling coral). Poles, throw nets, hand nets, lay

nets, and spears are commonly used. Aquarium fish collecting nets are rarely observed. By far the most efficient method (catch per effort), and in my opinion an unsustainable practice, is using lay nets in the shallow pools. The nets are tied across the mouths of isolated pools and then up to fifteen fishers herd the fish into the nets (pa'ipa'i style). Spear fishing at night for parrotfish (uhu) is also popular and efficient in the safety of the calm tide pools. Fishers report they generally have a high catch per effort at Wai'Opae.

Commercial Activities in MLCD

Although the MLCD rule prohibits commercial activities, including but not limited to commercial tours, dive groups, sightseeing tours, hikes, or guided services, many large guided groups routinely use the MLCD. Sometimes it is hard to distinguish between a commercially guided group and an educational group. University classes from Hawaii, Alaska, Massachusetts, and other places have snorkeled in the MLCD. Local schools and church groups bring busloads of young people. A guided group of disabled Japanese students was recently observed and encouraged to find a safer place to access the water than the very rough lava terrain. Guided groups are often observed staging out of anonymous, large-capacity rental vans, with no visible tour company logo.

Invasive Species

The invasive plant species, red mangrove (*Rhizophora mangle*), is rapidly colonizing the southern half of the MLCD. This species changes the habitat and is detrimental to native fish species found at Wai'Opae (VanderVeur and Beets, 2007).

Recommended Management Goals

The purpose of the Wai'Opae Tidepools MLCD, as stated in the rule, is to protect, conserve and improve the unique marine resources within the MLCD. It was broadly understood that "unique" marine resources included the unusually high density of juvenile fish in the nursery habitats provided by large complex of interconnected tide pools. The rule specifically prohibits all fishing and commercial activities. There was no stated purpose related to providing for general public use of the MLCD. There was a clear recognition, however, of the responsibility to provide for traditional and customary rights with regards to the wise and sustained use of the marine resources for subsistence, cultural, and religious practices, subject to the department's authority to manage these marine resources to prevent their overuse. Finally, the rule specifies that the department intends to review how effective the rules were in achieving these stated purposes within five years of the effective date.

The recommended desired future conditions, or goals, of the MLCD within five years of being designated (by July 2008) are:

- increased abundance and biomass of juvenile fish:
- increased abundance, biomass and average size of adult fish and invertebrate species targeted by fishers;
- relatively pristine coral reef with a low percentage of dead, broken or diseased coral;

- decreased cover of turf, coralline or macro algae due to increased abundance of herbivores and improved water quality;
- eradication of invasive species, especially red mangrove; and
- enhancement of adjacent fisheries (measured as legal-sized catch per effort by gear type) in tide pools and nearshore marine waters offshore adjacent to the MLCD through the spillover of adults or dispersal of larvae out of the MLCD and into areas open for fishing, although fisheries enhancement is not a stated purpose of the rule.

Recommended Management Objectives

- Ensure sufficient on-site enforcement of the MLCD and statewide fishing regulations at Wai'Opae by DLNR to achieve the MLCD purposes and desired future condition.
- Establish a permit application process and issue appropriate permits for allowable educational groups consistent with the purposes of the MLCD.
- Continue to monitor the effectiveness of the MLCD to scientifically determine if the rule, given the level of management and enforcement, is protecting, conserving and improving the marine resources within the MLCD. Report the monitoring results to the Board of Land and Natural Resources by June 16, 2008 regarding the effectiveness of the rule.
- Fund a DLNR biologist, biological technician, or ranger position to actively manage public use on site and educate visitors.
- Develop partnerships with non-governmental organizations and community groups that may help increase the cost-effectiveness of DLNR's management and enforcement activities at Wai'Opae tide pools. Help fund citizen's "makai watch" efforts that are deemed to be effective.

Recommended Management Activities to Accomplish Objectives

Enforcement

Increase DLNR-Division of Conservation and Resources Enforcement (DOCARE) presence at Wai'Opae so that the MLCD can be effective in achieving the stated purposes and the desired future condition.

- Increase the number of enforcement officers at Wai'Opae so they have a regular presence both day and night.
- Periodically hold a public meeting at Wai'Opae to explain the rule and answer any questions to increase the public's understanding and their compliance.
- Seek additional funding to properly equip DLNR- DOCARE officers (e.g., cell phones, portable computer with wireless internet, binoculars, cameras, night vision binoculars, etc.).

Empower citizen makai watch efforts so they can be effective "eyes and ears" for DLNR-DOCARE. Train them to accurately observe and report violations. Enable them to become DLNR volunteers and provide them with shirts and hats indicating their

connection with DLNR to increase their safety and effectiveness. Provide the reef stewards with binoculars, cameras and cell phones to allow for effective documentation and timely and safe reporting of violations.

Conduct the required public process to amend the MLCD rule to prohibit the possession of any fishing gear within the MLCD, for more effective enforcement of the rule, and to prohibit public access to the MLCD after sundown and before sunrise to reduce illegal night fishing.

Permitting

Establish a permit program to manage educational groups who want to use the MLCD in a non-commercial manner consistent with the purposes of the MLCD.

- If a permit for educational activities is requested, the department shall determine if the primary purpose of the activities is education or some other purpose and reserve the permitted activities in this fragile environment for those solely intended to teach students about the marine resources at Wai'Opae. Permits for group educational activities shall limit the activities to the least fragile areas of the MLCD and require a detailed briefing of all participants prior to entering the MLCD about the importance of not stepping on or touching any marine life. The permit shall require a report on the number of participants, date and location of educational activities.
- All permits that are issued shall be for a period not to exceed one year and shall require accurate reporting to DLNR-DAR on the allowed activities.
- Failure to submit the required reports or comply with any other terms or conditions of the permit shall result in the permit being revoked and non-renewal of the permit for one year from the date of permit revocation.
- All permits are non-transferable, unless otherwise specified on the permit.
- There is no vested right to a renewal or re-issuance of a permit. When reviewing an application for a permit, the department shall consider whether the applicant has previously violated or not complied with any term or condition of a permit and may deny the application on this basis.

Monitoring and Data Management

Continue to monitor the effectiveness of the MLCD to protect, conserve and improve the marine resources within the MLCD and report to the Board of Land and Natural Resources by June 16, 2008. Collaborate with the University of Hawaii at Hilo (UHH) and local organizations to increase the cost-effectiveness of the monitoring program to the extent practicable and scientifically-sound.

Develop and maintain a Geographic Information System (GIS) for the Wai'Opae MLCD and the adjacent control area used for monitoring. The GIS should include the location of all monitoring transects, a benthic habitat map, a water depth map that helps identify the risk of coral damage by visitors (see Holland and Meyers, 2003) (e.g., <2 m at mean low tide, 2-3 m at mean low tide, > 3 m at mean low tide), monitoring data and other information useful for management decisions.

Monitor human use patterns and the impact of visitors on the coral by observing the type and frequency of substrate contact by visitors to the MLCD. Use the methodology developed by Dr. Kim Holland and Dr. Carl Meyer (2003) and used at four other MLCDs to research the impact of snorkelers and divers. Focus observations in the most fragile areas (i.e., relatively abundant coral with mechanically fragile species and <2 m at 0.0 tide where there is moderate to high visitor use). Use this data to determine if the present human use patterns are causing damage to coral and, if so, in what locations.

Initiate creel surveys of people fishing in the Wai'Opae tide pools that remain open to fishing and trolling or diving offshore of the tide pools from the Pohoiki boat launch. Document trends in harvest level by species that inhabit Wai'Opae tide pools using data collected on catch-per-effort by gear type.

Share the results of the monitoring program with the public so they better understand the resource values of the MLCD and how effective the rule has been to protect, conserve and improve the public trust resources. Present the monitoring results at an annual meeting in the local area and answer questions about what the results mean. Seek recommendations from the public on management and enforcement activities.

Management

Maintain a DLNR position at Wai'Opae to actively manage and monitor public use at the MLCD. This person would educate the public about the MLCD and statewide fishing rules, the MLCD boundaries, why fishing and commercial activities are prohibited in the MLCD, why complying with the fishing rules is essential to maintain fisheries, why littering harms marine resources, and how to avoid damaging coral. They would also alert DLNR-DOCARE officers to violations for their formal enforcement actions.

Increase on-site management by supporting local makai watch participants to help DLNR educate visitors, collect data on human use patterns, and document violations and notify DLNR-DOCARE when they are observed.

Use the monitoring results to help identify the least fragile areas to direct visitors to in order to minimize their damage to the marine resources that the MLCD was established to protect, conserve and improve. Identify the most suitable locations in the MLCD for visitors to use. Direct the public to these locations in order to minimize adverse impacts to the shallow, fragile coral reef areas. Identify the easiest and safest routes from the shoreline to the least fragile areas in which to snorkel with strategic signage and/or an aerial photograph and map of the MLCD posted on the bulletin board.

Reduce or eliminate public access into the very shallow coral-filled pools that are being damaged by public. Consider installing signage at such pools requesting visitors to observe the marine life from above the water and to not enter the water because it is impossible to do so without breaking coral, which is illegal. Consider restricting the water entry and exit points to locations where coral will not be damaged.

Use all available biological and human use monitoring results to determine the human carrying capacity of the MLCD consistent with the purposes of the MLCD. Limit public use levels to the established carrying capacity by controlling number of parking spaces, in collaboration with the Vacationland Hawaii Community Association that owns and maintains the only access roads to the tide pools. Tow vehicles that are illegally parked.

Install and maintain additional State signs informing the public of the rule and the MLCD boundaries at strategic locations where people access the MLCD (e.g., along the waterfront road adjacent to the MLCD. More signage is essential along the north and south boundaries and at the Pohoiki boat ramp. Provide GPS coordinates of the seaward boundary in the Statewide Fishing Regulations and on the sign at the Pohoiki boat ramp.

Install and maintain an educational bulletin board along the shoreline of the MLCD. Post relevant information, including: MLCD rule; educational brochures and posters; why it's important to not trample, stand on or touch coral, feed fish, deposit human or dog fecal matter or litter because these activities degrade the marine environment; the best pools to snorkel (where it is the least fragile and safe); monitoring results from Wai 'Opae; and notices of meetings related to Wai 'Opae management.

Prohibit all kayaking because the shallow coral reef habitat makes it nearly impossible to kayak in the tide pools without breaking coral with the paddles.

Coordinate regular litter and marine debris clean-ups at Wai'Opae and provide garbage bags to encourage the public to pack out their wastes. Prohibit dogs below the shoreline of the entire tide pool area to reduce fecal pollution and the risk of leptospirosis. Fund the hauling away of the collected litter and marine debris to the County landfill or transfer station.

Adequately fund enforcement, management and monitoring of the MLCD. Consider implementing a user fee, such as at Hanauma Bay, if other funds are not adequate. The Kapoho Reef Watch Program's data on the number of annual visitors, visitor growth rates and percentage of visitors that appear to be non-residents provide a sound basis for the State to establish a user fee for public use of the State tidelands and pools. A 2003 survey at marine protected areas and other popular dive and snorkel sites in Hawaii - *Recreational Survey in Selected Marine Managed Areas in the Main Hawaiian Islands* – (Beukering et al. 2004) investigated the public's willingness to pay a user fee to help fund marine conservation. The study found that 79% of Mainland US visitors and 55% of Hawaii residents were willing to pay a user fee and a $5 fee per person per day was the most frequent amount acceptable by survey respondents. Those willing to pay were most interested in the funds being used to reduce water pollution, enforce conservation regulations, research and monitor coral reefs, and educate the public about the marine environment. Given the estimated 83,488 visitors to Wai'Opae in Year Four (ending March 2007), and the percentage of visitors driving rental cars (38% on weekends/Holidays and 49% on weekdays), a $5 per person per day user fee on non-residents only could generate over $185,000 per year. This would be more than adequate

to sustain intensive and effective on-site enforcement, management and monitoring at Wai'Opae.

Eradicate the invasive red mangrove (*Rhizophora* mangle) from the MLCD. It has rapidly overgrown approximately seven acres in the southern portion of the MLCD.

Consider forming a Wai'Opae Advisory Council with representatives from the local community and other stakeholders to function in a consultative capacity with DLNR staff and help bring stakeholders together. Members should represent a wide range of expertise and interest in the various actions considered for the MLCD.

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